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Key Lessons from the ExxonMobil Baton Rouge Refinery Isobutane Release and Fire

United States Chemical Safety and Hazard Investigations Board
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1. Introduction

On November 22, 2016, an isobutane release and fire seriously injured four workers in the sulfuric acid alkylation unit at the ExxonMobil Refinery in Baton Rouge, Louisiana (“Baton Rouge refinery”). During removal of an inoperable gearbox¹ on a plug valve,² the operator performing this activity removed critical bolts securing the pressure-retaining component of the valve known as the top-cap.³ When the operator then attempted to open the plug valve with a pipe wrench,⁴ the valve came apart and released isobutane into the unit, forming a flammable vapor cloud. The isobutane reached an ignition source within 30 seconds of the release, causing a fire and severely burning four workers who were unable to exit the vapor cloud before it ignited.

The CSB learned that there were long-standing reliability issues with gearboxes used to operate plug valves in the refinery’s alkylation unit. In addition, when alkylation unit operators encountered a malfunctioning gearbox on a plug valve, it was an accepted practice for the operator to remove the gearbox to open or close the valve with a pipe wrench. Baton Rouge refinery management did not, however, provide alkylation unit workers performing this operations activity with a written procedure or training on safe gearbox removal from plug valves and its associated hazards. While some operators felt comfortable performing this type of

¹ A gearbox is a mechanical device attached to a valve that uses gears to make it easier to turn the handwheel connected to the gearbox. This type of gearbox is also known as a gear operator. See [Tekval gear operator](#) (Tekval, 2001).

² See [animation of plug valve design and operation](#) (GM Engineers Pvt. Ltd, n.d.). A plug valve is used primarily for establishing flow when open or isolating flow when closed, and some throttling services. It controls flow by means of a cylindrical or tapered plug with a hole in the center that lines up with the flow path of the valve to permit flow. Plug valves are generally operated in either the open or closed position and are commonly used in the Baton Rouge refinery to isolate equipment.

³ [Durco plug valve parts and component names](#) (Flowserve, 2014) at page 3. Durco, the brand of the valve involved in the incident is among a number of Flowserve products. See [Flowserve product brands](#) (Flowserve, 2017).

⁴ The handwheel attached to the gearbox would not turn the stem of the valve when operated.

work, others did not and referred this work to maintenance personnel, who they felt were more qualified to remove the gearbox.⁵

The CSB also learned that 15 (approximately three percent) of the roughly 500 plug valves with manually operated gearboxes in the refinery's alkylation unit were an older design that required attaching the gearbox support bracket (**Error! Reference source not found.**) to pressure-retaining valve components. This design created the potential for incorrect removal of the gearbox, which can have catastrophic consequences, as seen in this incident. The improved valve design involves attaching the gearbox support bracket without connecting to pressure-retaining parts of the valve, allowing for safer gearbox removal.

The following safety bulletin highlights the details of the incident and its causes, provides key safety lessons, and communicates industry safety guidance with the goal of preventing a similar incident. The CSB urges companies to review the key safety lessons and safety guidance contained in this document for application at their facilities and to evaluate their existing process safety management practices and equipment design for potential improvements.

⁵ At the Baton Rouge refinery, maintenance personnel who would work on valves are referred to as "mechanical."